

Nurses Use of Health Status Data to Plan for Patient Care: Implications for the Development of a Computer-Based Outcomes Infrastructure

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The purpose of this study was to examine the relationships between the patient's health status at hospital admission and the initial care planned by the nurse. Functional status, engagement in care, and psychosocial well-being were measured by the Health Status Outcome Dimensions (HSOD) instrument. The HSOD is the foundation for developing a computer-based infrastructure for the analysis of health related outcomes. The consecutive, convenience sample of 308 subjects was drawn from five acute clinical populations: pulmonary; cerebrovascular; cardiac; gastrointestinal; and infection. Logistic and multiple regression analyses were used to test the relationships between control (patient and setting) variables, health status, and the dependent variables of type of problem identified, number of problems identified, and the time required to implement interventions ordered for the patient. In seven of ten models, control variables of facility, age, and/or severity of illness contributed to a model at $p < .01$. In six of ten models, at least one health status measure significantly explained variation beyond the control variables, at $p < .01$. Study results support using data gathered during the course of care, to evaluate the process of that care. Further work is needed to understand the effects of setting and provider variables on the use of health status data in care planning. Computer-based outcomes infrastructures are essential to support the collection and analysis of health status over time.

INTRODUCTION

A patient outcome reflects a spectrum of effects and thus requires diverse conceptual and measurement approaches to achieve an understanding of the phenomenon.¹ The science of nursing informatics is integral to this work as it links and transforms data collected over time and across settings of care, into essential information.² When these data are combined with those of the Nursing Minimum Data Set,³ an outcomes infrastructure is developed with which the processes and outcomes of care can be evaluated. Measures of health must be integrated with this infrastructure for true best practice analysis to occur. Combined administrative and health status databases support the study of the processes and outcomes of care

by linking: 1) the quality improvement process; 2) primary data collection and measurement; 3) statistical and analytical tools and 4) use of common vocabularies allowing for feedback and exchange.^{1,2}

The Health Status Outcome Dimensions (HSOD) is a generic health status instrument designed to measure the health status of the individual, family and/or caregiver, over time and across settings of care.⁴ Generic measures are those pertinent to domains of care which cross all populations, whereas condition-specific measures are germane to patients with unique characteristics which require specific variables and measures to reflect its care requirements.⁵ The HSOD includes measures of functional status, engagement in care, and psychosocial well-being: all phenomena sensitive to independent nursing practice. The value of the HSOD in supporting member health related outcomes is being tested prior to its inclusion in the developing clinical information system of a large health maintenance organization (HMO).

PURPOSE OF THE STUDY

To be of value, a computer-based, health-related outcomes infrastructure must capture the problems and interventions linked to the health status of the patient. The purpose of this study was to determine whether the patient's health status, as measured by the HSOD, was reflected in the nursing plan of care.

CONCEPTUAL FRAMEWORK

Health care occurs in a multicontextual, multicausal, multidisciplinary environment in which numerous variables can impact and interact with the relationship between an intervention and an intended outcome. The Outcomes Model for Health Care Research (OMHCR) captures this complexity.^{6,7,8} In this model, the intersection of the vertical axis of client, provider and setting with the traditional Donabedian⁹ elements of input/context, process and outcome, creates a nine cell matrix reflecting the major components of outcomes research as it is understood today. The value of the OMHCR lies in its ability to direct the researcher to the categories of potential covariates which require

measurement and evaluation in tangent with the primary relationship being studied.

In this study, variables of client, provider and setting were considered covariates or mediating variables. These input variables mediate the effect of the independent variables of functional status, engagement in care, and psychosocial well-being, and the dependent provider process variable of care planned by the nurse. Patient and setting variables which could impact the relationship between admission health status assessment and the writing of the plan of care were measured.

STUDY QUESTIONS

After controlling for patient and setting characteristics: (1) Do the admission HSOD health status factor scores (HSFSs) of functional status, engagement in care, and psychosocial well-being, predict the problems identified by the nurse at the time of hospital admission of the patient? (2) Do the HSFSs predict the number of problems identified by the nurse for the patient? (3) Do the HSFSs predict the time required to implement the interventions selected by the nurse for the patient?

METHODOLOGY

Design

A passive-observational, cross-sectional¹⁰ design was used as it supported the use of informatics to capture and observe processes and sequences as they occurred naturally in the environment. This design does not manipulate any naturally occurring variables which could rule out sources of variation, and yet allows the use of correlational and regression techniques to determine whether certain variables covaried with others.

Setting

Two acute care hospitals in a large HMO in the Northern California area were the settings for this study. The facilities and the medical/surgical units were selected because the HSOD had been incorporated into their paper-based documentation system, and because of minimal overt sources of variation between sites.

Study Sample/Sample Size Requirements

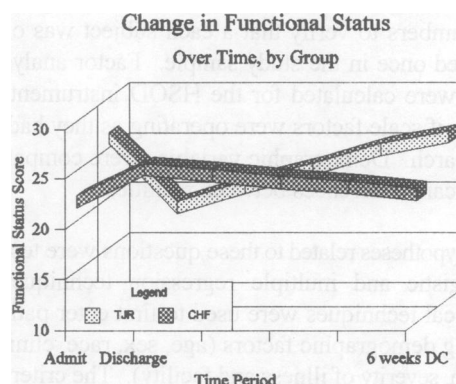
The convenience, consecutive sample consisted of 308 subjects. Study criteria included: a minimum age of 18 years; a minimum length of stay of 24 hours; and an admitting clinical diagnosis which fell into one of the following medical groups: pulmonary, cardiac, cerebrovascular, gastrointestinal and infection. The minimum sample size of 245 was determined using a statistical software program based on sample size methodologies developed by Cohen.¹¹ A desired power of .80 and conservative estimates of effect size (percent

of explained variance) were used in the analysis.

Instruments

Prior research had demonstrated the content and construct validity of the HSOD.¹² In a descriptive, correlational study, patients undergoing total joint replacement (TJR) and patients admitted in congestive heart failure (CHF) were studied to determine the sensitivity of the HSOD to patient population and to time. A 2 X 3 (population X time) ANOVA for TJR and CHF demonstrated a significant main effect of time ($F = 8.0$, $p = .0006$) and a significant interaction effect between time and population ($F = 14.4$, $p < .0001$) for functional status. The results supported the sensitivity of the HSOD to patient population and to time. Figure 1 illustrates the change in functional status over time for the CHF and TJR samples. With this type of data, the following question can now be asked. "Which model of care maximizes the positive slope post TJR, and minimizes the negative slope post discharge of the CHF patient?"

Figure 1



The internal consistency reliability (ICR) of the HSOD had also been demonstrated.¹² Internal consistency has been defined as the preferred measure of reliability in multi-item, multitrait scales.¹³ The ICR as measured by a standardized alpha was adequate for all HSOD factors: functional status = .91; engagement in care = .69; psychosocial well-being = .77; caregiver status = .67; and family status = .83.

Data Collection Methods

Retrospective chart review was used to collect the primary study data including: clinical population; age; gender; race; HSFSs; and identified patient problems. Patient problems were categorized as HSOD related (knowledge, mobility, psychosocial well-being) and other. A program was written to retrieve severity of

illness and intervention data from the mainframe databases. Severity of illness was derived from a vendor-supported software program designed to predict resource utilization for clinically related groups, with relative severity based on the presence of ranked classes of secondary diagnoses.¹⁴ Time to implement interventions was derived from a workload measurement system and summed into three groups: activities of daily living; teaching and emotional support; and other direct care.¹⁵

Procedure

Following approvals by the human subjects review boards of the HMO and the university, potential subjects were identified based on a mainframe-based program incorporating study criteria. All chart reviews were completed by the principal investigator with data entered directly into a laptop computer. Mainframe data were pulled 60 days following the last discharge date providing sufficient time for the coding of the case and the assignment of severity of illness levels.

The statistical program used to collect the data was programmed to provide alerts for data which exceeded defined parameters. Frequencies were run on medical record numbers to verify that a each subject was only represented once in the study sample. Factor analyses and ICR were calculated for the HSOD instrument to determine if scale factors were operating as they had in prior research. Demographic variables were compared for significant differences between facilities.

The null hypotheses related to these questions were tested using logistic and multiple regression techniques. Hierarchical techniques were used to first enter patient and setting demographic factors (age, sex, race, clinical population, severity of illness and facility). The criterion for entry of the HSOD factors to the final model or equation was achieving a level of significance of .01.

RESULTS

The sample of 308 was predominantly white (77.6%), female (53.3%), with a mean age of 65.6 years. The overall severity of illness was relatively low (mean .71; range 0 to 3) for the sample which was line with the average length of stay of 4.38 days. The sample sizes of the five clinical populations varied between 47 (cerebrovascular) and 79 (infection). There were no significant differences in the distribution between the facilities of the pulmonary, cerebrovascular and infection populations, when compared to the overall sample distribution. In contrast, 98.2% of the cardiac population was found in facility two as was 62.3% of the gastrointestinal population. Of concern was the possibility, that due to sampling error, facility would

falsely appear to explain a significant amount of variation in the dependent variable.

ANOVA and chi-square analyses were used to test whether facility, HSFSSs and clinical population were explaining different sources of variation in the dependent variables (Table 1). There were no significant effects of facility on the independent variable HSFSSs. There were statistically significant effects of clinical population on all of the HSFSSs. Facility was a variable of significance only in relation to the dependent variables, and then not consistently. Despite considerable homogeneity between the clinical populations, facility one had twice the mean number of health problems identified (\bar{m} = 1.46) than did facility two (\bar{m} = .69). Similarly, the mean time for teaching and emotional support interventions was almost five times more in facility one (\bar{m} = 2.03 hrs) than facility two (\bar{m} = 0.46 hrs). The results supported retention of facility as a covariate, since the HSFSSs (the independent variable) did not vary between facilities, whereas the dependent variables did vary.

Table 1 - Significant ($p < .001$) Relationships Between Facility, Clinical Population and HSOD HSFSSs, Health Problems Identified and Time to Implement Interventions ($n = 308$)

Variable	Fac ¹	CP ²
<u>HSOD HSFSS</u>		
Functional Status	no	yes
Engagement in Care	no	yes
Psychosocial Well-Being	no	yes
<u>Number Problems Identified</u>		
Health Status Problems	yes	yes
Other Problems	no	no
All Problems	yes	no
<u>Time Implement Interventions</u>		
Teaching/Emotional Support	yes	yes
Activities of Daily Living	yes	yes
Other Direct Care	no	no
<u>Type of Problem Identified</u>		
Knowledge	yes	no
Mobility	no	no
Well-Being	yes	no
Other	no	no

Fac¹ Facility; CP² Clinical Population

Principal components factor analysis with varimax rotation was used to determine the HSOD subscales. As in prior research,¹² the patient variables fell into three subscales: functional status; engagement in care; and psychosocial well-being. The ICR as measured by a standardized alpha was adequate for group comparisons for all factors: functional status = .95, engagement in care = .80, and psychosocial well-being = .79, caregiver

engagement = .80, and family well-being = .83.^{16,17}

Pearson product-moment correlations were calculated between the major study variables and the HSFSSs (Table 2). On the HSOD, higher scores are associated with increased health, so decreased functional status was related to increased age ($r = -.339$). The correlations provided additional support for the validity of the HSOD.

Table 2 - Pearson Product-Moment Correlations of Variables Achieving Significance ($p < .01$) $n = 308$

Variable	FS ¹	EC ²	P/S WB ³
Age	-.339	-.232	-.169
Severity Illness	-.165		
Mobility Problem ID'd	-.410	-.404	-.250
Well-Being Prob ⁷ ID'd			-.220
# ⁴ Health Status Prob ID'd	-.304	-.250	-.291
# Other Prob ID'd	-.298	-.234	
Total # Prob ID'd	-.354	-.302	-.249
Time T&ES ⁵ Interventions	-.190		-.153
Time ADL ⁶ Interventions	-.570	-.476	

¹Functional Status; ²Engagement in Care; ³Psychosocial Well-Being; ⁴Number; ⁵Teaching & Emotional Support; ⁶Activities of Daily Living; ⁷Problem.

Table 3 - Summary of Hypothesis Testing and Variables Contributing to Explanation of Variance

Dependent Variable	Sig ¹ Control Variable	Hypothesis A ² or R ³	HSFSS Sig
Knowledge ID'd	Facility	A	None
Mobility ID'd	None	R	FS ⁴ , EC ⁵
P/S ⁶ Well-Being	Facility, Age	A	None
Other ID'd	None	A	None
# Health Status	Facility	R	P/S ⁶ , FS
#Other ID'd	None	R	EC
#All Probs ID'd	Facility, Age	R	EC, FS
Time T&ES ⁹	Facility	R	FS
Time ADLs ¹⁰	SOI ⁷ , Fac ⁸ , Age	R	EC, FS
Time ODC ¹¹	SOI, Fac	A	None

¹Contributed to model or equation at $p < .005$; ²Null Hypothesis Accepted ($p > .01$); ³Null Hypothesis Rejected ($p < .01$); ⁴Functional Status; ⁵Engagement in Care; ⁶Psychosocial Well-Being; ⁷Severity of Illness; ⁸Facility; ⁹Teaching & Emotional Support; ¹⁰Activities Daily Living; ¹¹Other Direct Care.

A total of ten hypotheses were required to fully answer the three study questions. Four hypotheses were tested with logistic regression techniques to determine whether the HSFSSs, over and above the control variables, contributed to explanation of variation in whether a particular problem type was identified at least once for the patient. The remaining six hypotheses were tested using multiple regression techniques. Table 3

summarizes results of testing, including the control variables with contribution at $p < .01$, and HSFSSs with added contribution at $p < .01$. The total amount of variation (as described by the adjusted R squared) explained by the final regression models varied from 4.6% (number of other problems), to 18.1% (total number of problems), to 24.1% (health status problems).

DISCUSSION

The two facilities participating in this study were selected for what was thought to be a minimal amount of variation. The two acute care facilities are 22 miles apart, are within the same HMO, share the same administrative and nursing leadership, and had implemented the same model of care with the same documentation. Even though the HSFSSs did not differ significantly between the two facilities, there were large differences in the care planned by the nurse in the areas of engagement in care and psychosocial well-being. The variation in care planning did not occur in the identification of problems and interventions relating to functional status or to problems and interventions related to the physiological basis for admission (i.e., decreased cardiac output or ventilation).

The original study design called for the collection of nurse demographic data as possible covariates of the care planning process. Unfortunately, these data were not able to be collected during the study period. It was therefore not possible to determine whether facility based variation was due to setting versus provider differences.

The HSFSSs contributed to the explanation of the variation in care planning over and above that explained by patient and setting variables. Despite the small effect sizes, the data collected during the normal assessment process were able to point to the existence of a major variable impacting practice at the two facilities. Future research will be required to isolate that variable(s).

For each problem group (health status, other, total), all three of the HSOD factor scores were eligible to enter the regression equation ($p < .001$) at the end of step one. The psychosocial well-being (6.5%) and functional status (2.9%) HSFSSs were part of the final model for the "number of health status problems" selected. Engagement in care was the only HSFSS in the final predictive equation for the "number of other problems identified," contributing 4.4% to the explanation of variance. The final model for the "total numbers of problems identified" included engagement in care (8%) and functional status (2.9%).

The entry of functional status into the predictive models for numbers of health status problems and the total

number of problems was anticipated, as activities of daily living are driven by both physician and nursing orders. More difficult to interpret is that engagement in care was the only HSFS entering the final model for other problems identified, and the factor with the greatest contribution to the explanation of variance (8.0%) in the total number of problems identified model. It is important to not jump to "cause and effect" conclusions given the study design and the small contribution of engagement in care to the explanation of variance. As managed care seeks ways to reduce the short and long term costs of care, models are being tested which focus on engaging the client as active partners in their care, and providing knowledge to support their self-care. Results support the use of the HSOD within an outcomes infrastructure to monitor the effectiveness of these programs.

IMPLICATIONS

Clinical databases using data collected during the course of care can provide insight into the quality of the care provided by health care systems. To analyze these data in the absence of data reflecting the possible covariates of the client, provider and setting, limits the researcher's ability to achieve a complete understanding of the phenomenon of study. Both standardized outcomes instruments such as the HSOD and standardized coding and classification systems are building blocks for such structures.

Acknowledgements

The author acknowledges the support of the nursing leadership and the nurses of the Kaiser Permanente Medical Care Program, Northern California Region. The direction and support of Dr. William Holzemer and Dr. Erika Froelicher were invaluable. This research was partially supported by a predoctoral fellowship from the Agency for Health Care Policy & Research (# T32 HS00026-10). The design of the HSOD was based on the Quality Audit Marker (QAM) for HIV/AIDS.¹⁸

References

1. Henry SB, Partridge R, Lenert LA, Middleton BF. Linking process and outcome with an integrated clinical information system. *Proceedings of HIMSS 93*. 1993; 2:58-79.
2. Henry SB. Informatics: Essential infrastructure for quality assessment and improvement in nursing. *JAMIA* 1995; 2:169-182.
3. Werley HH, Lang NM. *The consensually derived nursing minimum data set*. NY, NY:Springer.1988.
4. Lush MT, Jones DL, Outcomes Taskforce. Developing an outcomes infrastructure for nursing. *JAMIA Symposium Supplement, SCAMC Proceedings*. Am Med Informatics Assoc. Philadelphia, PA: Hanley & Belfus, Inc. 1995:625-629
5. Zielstorff RD. Capturing and using clinical outcome data: Implications for information system design. *JAMIA* 1995; 2:191-196.
6. Holzemer WL. (1992). Nursing effectiveness research and patient outcomes: A challenge for the second HIV/AIDS decade. *Crit Care Nurs Clinics of N Am*, 1992; 4:429-435.
7. Holzemer WL. The impact of nursing care in Latin America and the Caribbean: A focus on outcomes. *J Adv Nurs*. 1994;20:5-12.
8. Holzemer WL, Reilly CA. Variables, variability, and variations research: Implications for medical informatics. *J Med Informatics Assoc*. 1995;2:183-90.
9. Donabedian, A. *Explorations in Quality Assessment and Monitoring: The Definition of Quality and Approaches to its Assessment Vol II*. Ann Arbor, MI: Health Administration Press. 1982;1:109-119.
10. Cook TD, Campbell DT. *Quasi-Experimentation: Design & Analysis Issues for Field Settings*. Boston: Houghton Mifflin Co. 1979.
11. Cohen, J. (1988). *Statistical Power Analysis for the Behavioral Sciences, 2nd ed*. Hillsdale, NJ: Lawrence Erlbaum Associates, Publishers.
12. Lush MT, Henry SB, Foote K, Jones DL, Outcomes Taskforce. Developing a generic health status measure for use in a computer-based outcomes infrastructure. Accepted for publication by *IMIA Sixth International Nursing Informatics Conference*. 1997.
13. Stewart AL, Ware JE Jr. *Measuring Functioning and Well-Being*. London: Duke University Press. 1992.
14. Leary R, Leary R, Dove H. Research review: Refined diagnosis-related groups -- A new perspective on patient classification. *Topics in Health Information Management*. 1993;14:77-87.
15. Meyer D. *GRASP: A patient information and workload management system*. Morgantown, NC: MCS. 1978.
16. Helmstadter GC. *Principles of Psychological Measurement*. New York, NY: Appleton-Century-Crofts, Inc. 1964.
17. Nunnally JC *Psychometric Theory, 2nd Ed*. New York, NY: McGraw-Hill. 1978.
18. Holzemer WL, Henry SB, Stewart A, Janson-Bjerklie S. The HIV Quality Audit Marker (HIV-QAM): An outcome measure for hospitalized AIDS patients. *Quality of Life Research*. 1993; 7:99-107.